DOCUMENT RESUME

ED 374 013 SE 054 948

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TITLE The Effect of Wider Participation among Women of Color on Science Teaching and Science Teacher Education.
PUB DATE Apr 94
NOTE 11p.; Paper presented at the Annual Meeting of the American Educational Research Association (New Orleans, LA, April 5-8, 1994).
PUB TYPE Reports - Research/Technical (143) -- Speeches/Conference Papers (150)

EDRS PRICE MF01/PC01 Plus Postage.
DESCRIPTORS Elementary Secondary Education; Higher Education; *Minority Groups; Science Careers; *Science Education; *Teacher Educators; *Women Faculty

ABSTRACT

It is a safe assumption that the increasing influx of women of color in science education will over time redefine and have an impact on the process and system that educate them. With inclusion comes additional methods of confronting issues, many of which may include alternative modes of teaching and maintaining diverse populations in science. The impact of women of color on this non-traditional teaching arena will most probably be felt on two fronts principally: (1) Science teacher education theory and practice; and (2) Science education for students at all levels of the educational spectrum. This paper focuses on some of the more apparent ways that wider inclusion and representation among women of color in science education may affect these two fronts. The outcome of critical scrutiny regarding the influence of both gender and ethnicity on science education curricula may serve to increase participation and persistence among students in science or science education careers. In addition, investigations of this sort may ultimately yield methods for recruiting and retaining more women of color in science and science education; women grounded in the experiences of others who have successfully met the rigor and institutionalized biases that face ethnic minorities in science. Contains 13 references. (Author)

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ED 374 013

The Effect of Wider Participation Among Women of Color on Science Teaching and Science Teacher Education

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Paper Presented at the Annual Conference of the

American Educational Research Association

April, 1994

New Orleans, LA

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Abstract

It is a safe assumption that the increasing influx of women of color in science education will over time re-define and have an impact on the process and system that educates them. With inclusion comes additional methods of confronting issues, many of which may include alternative modes of teaching and maintaining diverse populations in science. The impact of women of color in this non-traditional teaching arena will most probably be felt on two fronts principally:

- Science teacher education theory and practice; and
- Science education for students at all levels of the educational spectrum.

This paper focuses on some of the more apparent ways that wider inclusion and representation among women of color in science education may affect these two fronts.

The outcome of critical scrutiny regarding the influence of both gender and ethnicity on science education curricula may serve to increase participation and persistence among students in science or science education careers. In addition, investigations of this sort may ultimately yield methods for recruiting and retaining more women of color in science and science education; women grounded in the experiences of others who have successfully met the rigor and institutionalized biases that face ethnic minorities in science.

Introduction

Being both an ethnic minority and a female in the United States constitutes what is called the 'double minority' (Samuda & Wolfgang, 1985). When women of color pursue careers involving scientific endeavors however, they become a triple minority. Women of color are severely underrepresented in science related career fields. At all grade levels, Hispanic, Hawaiian, and African American women lag far behind white males in scientific knowledge attainment (U.S. Department of Education, 1993). Of those few that pursue science related careers, they on average will be paid no more than 85 percent of their white male counterparts.

The number of ethnic minority women continues to outpace those who are members of the majority culture. At present, the Latino population is the fastest growing segment of United States society, followed closely by African American population growth. Yet trying to find any extensive information on Latino and African American women scientists remains as difficult as trying to find a needle in a haystack. The number of native Hawaiian women scientists is even smaller. With women constituting some 51 percent of all United States residents, it becomes fiscally irresponsible to overlook their value to scientific enterprises. It is becoming increasing necessary to critically examine the culture of these women to assist them in making a larger place for themselves within the scientific enterprise.

Women of Color and Culture

Cultural Norms and Values

Latinas like many other women of color come from a patriarchal society and family structure. Latinas have a prescribed role in their society that usually doesn't include work outside the home unless absolutely necessary. Assertiveness in Latinas is not as valued in their culture as good parenting and family management skills. Some Latina children have been taught that it is impolite to look adults in the eye while they are speaking to them. While in many ways this is

changing, the culture of western science should also begin the process of change to accommodate Latinas.

Hawaiian cultural values in many instances, contradict those of western science as well. Hawaiians value human relationships, family, interpersonal harmony, and egalitarianism instead of competition and valorization of individual accomplishments. An individual who stands out by being forward, asking too many questions, or seeking higher status than peers is called *mahaoi* (Boggs, 1985). An individual showing these undesirable traits is shunned and disliked for creating social hierarchy, instead of social equivalence. Leadership is attained through age, humility, and the recognition of others, instead of through personal assertiveness (Linnekin, 1980; Solomon, 1981). In school settings, these cultural values lead to 'deficient' verbal and academic performance when individual competition, ranking, and individual question-response patterns are normative.

African Americans belong to a culture that does not revolve around hierarchical relationships in the same manner as western science. Much of the culture relies on the interdependence of people on each other. A study of persistence of African American science students at predominately white research universities was performed by Hines (1993). She found that for women, the connectedness of clubs and churches helped them maintain a balance against the isolation they experienced in the college science classroom. This, in turn helped African American women persist in their pursuit of science majors when they felt disconnected from the university environment.

In considering this brief account of some of cultural norms and their relation to ethnicity and gender, it should be expected that there would be little place for women of color who hold steadfastly to their cultural values. It is unfortunate that the norms and values of these minority cultures are not valued as such in science classrooms.

Traditional science classrooms take on a hierarchical structure that places ethnic minority and female relational styles at its lowest rung. The production of quantitative evidence is more

highly valued than qualitative evidence. Empirical data reigns supreme. Greater emphasis is placed on science processes and content than on science applicability and relevance. Assertiveness and independent work are rewarded. The difference between the cultural norms of these women and the norms of western science can leave them confused and unable to satisfy the expectations of either group. The following section discusses the cultural dissonance that this can occur as a result.

Cultural Dissonance

Women of color in sciences walk a tightrope between accommodating the expectations of their home communities and scientific community. They have few like role models in science to help them define themselves within their own cultural contexts. Trying to do so in isolation can become frustrating and unrewarding. There is little immediate reward for acting outside the cultural norms of their home communities. Unless they are ultimately successful, many people in their home communities do not understand their need to express themselves through scientific endeavors.

The Latino culture includes a certain 'machismo' that doesn't necessarily envision the scientist as female. Puerto Rican women living in New York were studied by Soto and Shaver (1982). The researchers primarily investigated 'machismo' and female 'submissiveness'. They found these women suffered from depression, somatization, phobic anxiety, and conflict around gender role norms and inhibition of assertiveness. These women endured illnesses prompted by the dissonance they experienced as they moved out of the norms of their home cultures. As they struggled for acceptance within a broader community, they often lose immediate acceptance in the home community.

If Hawaiian women act outside their cultural norms in a pattern that is valued by western science, other Hawaiians are likely to 'talk stink' about them. This is also true of African American women who are likely to be told that they are 'acting white'.

science. Malgady, Rogler, and Constantino (1990) investigated a preventive intervention program designed to promote heroine modeling for culturally Puerto Rican adolescents. Their findings indicated a need to call attention to the importance of considering the population's social context. We suspect that similar studies of native Hawaiian and African American women would produce similar results.

Science teacher educators must take the lead in educating pre-service and in-service science teachers about the influence of culture on classroom practices. If we consider the case of the Latina who is told that it is impolite to look adults in the eye when they are speaking, what happens when this girl's teacher does not know this? Does this teacher view the girl as aloof, or less intelligent than other students? What happens if the teacher begins to treat the girl differently because of this perception? It is this ignorance of culture that turn can turn girls away from science altogether.

Science teacher educators should collaborate with other professionals familiar with various issues in the sociology of science. They may be able to help put some of the cultural aspects of science teaching in context.

Systematic inclusion of cultural and gender studies should be included in science methods classes. This can be accomplished by examining the cases of women of color who have successfully pursued science careers. Another exercise that is especially useful is the critical examination of videotapes of science teaching in the multicultural classroom settings.

Finally, serious attention must be paid to gender and culture sensitive assessment in science education. Culturally sensitive authentic assessment performance based assessment and open ended questioning, though controversial, may also serve to assess other factors that promote success in women of color

Recommendations for Science Education

Science education has undergone a number of reforms designed to make the curricula in science classes more relevant. It is also moving toward more student-centered, collaborative team effort activities. Students are discussing their own understand of the science concepts that they

One of the few institutions in which African American women are more likely to be nurtured for their academic ability in science is the Historically Black College or University (HBCU). Consider that in 1989, the University of Minnesota-Twin Cities, The Ohio State University and the University of Texas-Austin respectively had the largest undergraduate enrollment in the United States. Nevertheless, during that year, none of these institutions ranked in the top 34 in Baccalaureate degrees conferred to African Americans in physical sciences, life sciences, and engineering/computer science/math (Black Issues in Higher Education, 1992). Contrast this with the three largest Historically Black Colleges and Universities, Howard University, University of District of Columbia, and Southern University-Baton Rouge, in 1992 (Black Issues in Higher Education, 1992b). During 1989, these institutions ranked in the top 15 in Baccalaureate degrees conferred to African Americans in physical sciences, life sciences, and engineering/computer science/math (Black Issues in Higher Education, 1992). More specifically, Howard, UDC, and Southern conferred degrees to their majors at a rate of 75.8%, 100%, and 100% in the physical sciences, 83.1%, 100%, 100% in the life sciences, and 77.9%, 90.4%, and 89% in engineering/computer science/math, respectively (Black Issues in Higher Education, 1992).

While the number of students the HBCU's enroll is typically fewer, it can be inferred that something very different is happening with regard to African American women at these institutions. Perhaps an understanding and respect of their culture makes it possible for them to excel. The importance of infusing culture into science teacher education and practice will be examined in the next section.

Science Teacher Education Theory and Practice

The (Re)Education of Science Teachers

Women of color should not have to leave their cultures behind to pursue scientific endeavors. Perhaps this would not be the case if science teachers and science teacher educators placed greater emphasis on the home cultures of their students rather than on the culture of western

study within the classroom setting more. It allows for more discovery. These reforms are ideal for many women of color. The culture of many of these girls involves learning through listening, discussing and modeling. Science teachers in many instances rely on forms of instruction that rank students by written test performance (Lemke, 1990). For these girls, being able to articulate their understanding is more important than being able to write it in the beginning.

Many scientists agree that in actuality they do work in teams and collaborate. They discuss scientific issues and concepts amongst themselves. Even though they understand and respect the concept of the scientific method, they are equally led by hunches and serendipity. It is very probable that most students don't understand that. They need to know that not even scientists arrive at all of their conclusions linearly.

Traditional science classroom practices are changing to more accurately reflect the needs of a technological society. Most notable is the Science, Technology, and Society (STS) movement. It is believed that by making science less abstract, more students will persist when the content becomes harder. Since women of color are prone to ask how a particular concept relates to me and to my community, we speculate that more women of color would also persist.

The use of role models in the community is also another way of letting women of color know that other like themselves have successfully pursued science careers. Researchers have long identified the absence or presence of suitable role models in the lives of minority students as extremely important (Wilson, 1987 & Young, 1983). No matter how much a girl is told that she can do anything that she wants to do, she is more apt to believe it from someone who looks like her or has lived a similar experience.

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